CLAIMS

1. Method for manufacturing a diamond film (8) using a pulsed microwave plasma, in which, in a vacuum chamber (1), a plasma (7) of finite volume is formed near a substrate (5) by subjecting a gas containing at least hydrogen and carbon to a pulsed discharge, which has a succession of low-power states and high-power states, and having a peak absorbed power P_c, so as to obtain at least carbon-containing radicals in the plasma (7) and to deposit the said carbon-containing radicals on the substrate (5) in order to form a diamond film (8) thereon;
characterized in that power is injected into the volume of the plasma with a peak power density of at least 100 W/cm^3 while maintaining the substrate (5) to a substrate temperature of between 700°C and 1000°C.

2. Method according to Claim 1, in which a plasma (7) having at least one of the following features is generated near the substrate (5):

· the pulsed discharge has a certain peak absorbed power P_c and the ratio of the peak power to the volume of the plasma is between 100 W/cm^3 and 250 W/cm^3,

· the maximum temperature of the plasma is between 3500 K and 5000 K,

· the temperature of the plasma in a boundary region of the plasma located less than 1 cm from the surface of the substrate is between 1500 K and 3000 K and

· the plasma contains hydrogen atoms having a maximum concentration in the plasma of between 1.7×10^{16} and 5×10^{17} cm^{-3}.

3. Method according to Claim 1 or Claim 2, in which said gas contains carbon and hydrogen in a carbon/hydrogen molar ratio of between 1% and 12%.

4. Method according to any one of the preceding claims, in which said gas contains at least one hydrocarbon, and a plasma (7) having a concentration of the carbon-containing radicals of between 2×10^{14} cm^{-3} and 1×10^{15} cm^{-3} is generated.

5. Method according to any one of the preceding claims, in which a pulsed discharge is produced, in which the ratio of the duration of the high-power state to the duration of the low-power state is between 1/9 and 1.

6. Method according to any one of the preceding claims, in which at least one of the following parameters is estimated:

· a substrate temperature,

· a temperature of the plasma,

· a temperature of the plasma in said boundary region, located less than 1 cm from the surface of the substrate,

· a concentration of atomic hydrogen in the plasma,

· a concentration of carbon-containing radicals in the plasma,

· a concentration of carbon-containing radicals in said boundary region close to the plasma,

· a pressure of the plasma and

· a power density of the plasma,

and the power emitted as a function of time is adapted according to at least one of these parameters.

7. Method according to any one of the preceding claims, in which the plasma is contained in a cavity (13) with at least one of the following properties:

· the pulsed discharge has a peak power of at least 5 kW at 2.45 GHz,

· the pressure of the plasma is between 100 mbar and 350 mbar and

· the gas containing hydrogen and carbon is emitted with a ratio of the flow rate to the volume of the plasma of between 0.75 and 7.5 sccm/cm^3.

8. Method according to any one of Claims 1 to 6, in which the plasma is contained in a cavity with at least one of the following properties:

· the pulsed discharge has a peak power of at least 10 kW at 915 MHz,

· the pressure of the plasma is between 100 mbar and 350 mbar and

· the gas containing hydrogen and carbon is emitted with a ratio of the flow rate to the volume of the plasma of between 0.75 and 7.5 sccm/cm^3.